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Optical Hall conductivity in QHE systems TAKAHIRO MORIMOTO, Universtiy of Tokyo, YASUHIRO HATSUGAI, University of Tsukuba, HIDEO AOKI, Universtiy of Tokyo — While the quantum Hall effect is among the most remarkable static properties of two-dimensional electron systems at low temperatures in magnetic fields, recent advances in optics in the THz region make spectroscopic measurements of the Hall angle possible in magnetic field of a few tesla. So a natural question we pose here is: can the quantum Hall effect, a topological phenomenon, evolve into an "optical Hall conductivity" in the ac regime, especially in the THz region which is the cyclotron energy scale. Motivated by this, we have theoretically calculated the optical Hall conductivity $\sigma_{xy}(\omega)$ for the ordinary quantum Hall system with Kubo formula, where the effect of disorder is taken into account with the self- consistent Born approximation. The result shows that the Hall plateaus do remain in the optical (THz) region when the disorder is not too large. Next we have extended the calculation to the graphene QHE system, and found that the optical Hall conductivity $\sigma_{xy}(\omega)$ reflects the massless Dirac dispersion and the associated Landau level structure. While the Hall palteaus are again retained in the ac region against disorder, the structure at the central ($N = 0$) Landau level is particularly robust. We predict such phenomena should be measurable through an accurate detection of the Hall angle in the THz regime.

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